ZOOLOGICAL SCIENCE 7: 547–549 (1990)

[COMMUNICATION]

Photoperiodic Influences on Pheromonal Delay of Puberty in Young Female Wild Mice

SUBHASH C. PANDEY and SHEO D. PANDEY

Department of Zoology, Christ Church College, Kanpur, India

ABSTRACT—Individually housed young females were painted on their external nares with distilled water or urine collected from donor females subjected to different photoperiodic treatments. Young painted with distilled water attained puberty significantly earilier than those painted with urine from donors under laboratory light condition or under short photoperiod. Urine of donors under long photoperiodic treatment did not delay the pubertal onset as the mean time taken for occurrence of first vaginal estrus in such urine-painted young was not significantly different from that of water-painted control young.

INTRODUCTION

Urinary pheromones in laboratory mice can accelerate or delay the onset of puberty in juvenile females. Sexual maturation of prepuberal females is accelerated by exposure to adult males or to their urine [1]. Young females living in groups or raised with adult females attain puberty later than those living in isolation [2]. The delaying effect is chemically mediated through urine collected from grouped females [3]. The acceleration and delay of puberty also occur in wild mice and the causative factors have been found to be present in the urine of male and female, respectively [4].

Naturally occurring variations in environmental factors influence the efficiency of different chemosignals modulating various physiological and behavioral activities in mammals [5]. Seasonal variation has been reported in pheromonal acceleration and delay of puberty in female laboratory mice [6]. Continuously breeding house mice exhibit seasonal patterns of reproductive activity in certain regions [7]. Long diurnal photoperiod (16L:8D) abolishes mutual suppression of estrus in sparsely housed females at 36–38°C (our unpublished observations). For animals inhabiting wild, the interactions between social and environmental factors are potentially important. The present effort was therefore aimed to determine the relative influence of the day length and the puberty-delaying chemosignal of female origin on sexual maturation in young females.

MATERIALS AND METHODS

The wild mice, *Mus musculus domesticus*, employed in this study were trapped from the field and maintained in the laboratory on a diet consisting of soaked gram, boiled rice and milk. Water was available *ad libitum*. Forty eight prepuberal females (subject females) weighing 4.6 ± 0.58 g were randomly divided into 4 groups and housed individually in isolation cages ($34 \times 18 \times 14$ cm) under laboratory conditions of light (ca 13 hr) and temperature (30–38°C). There were 8 females in group A and D and 16 each in group B and C. The subject females were painted daily on the their external nares with distilled water (group A) or with diluted urine pooled from different donor females (group B, C and D; Table 1).

Adult females which served as donors were housed in colony cages ($30 \times 30 \times 30$ cm) at a density of 10 mice/cage. These donors were either held under laboratory light condition (LLC) or exposed to cool white fluorescent light of long (16L : 8D) and short (8L : 16D) duration at an

Accepted August 15, 1989
Received June 19, 1989

Table 1. Mean time taken for the occurrence of first vaginal estrus in young females painted with water or urine from donor females exposed to different photperiods

Group	Painting material	Mean time (in days) taken for first vaginal oestrus to occur
A	Water (control)	27.3±0.78*
B	Urine of donors under long photoperiod (16L:8D)	28.4±0.35
C	Urine of donors under short photoperiod (8L:16D)	36.6±0.53*
D	Urine of donors under LLC	36.9±0.88

* Means connected with same vertical line are at par at 5% level of significance.

intensity of about 400 lux. The above photic treatments of donor females commenced 15 days before their urine was used in the experiment. Fresh urine was collected daily from all the donors by manual bladder palpation and diluted in distilled water (1:9). A drop (0.05 ml) of urine was applied twice daily at 9:00 and 17:00 hr with the help of a small paint brush and subjects were examined for the appearance of vaginal perforation. Starting on the day of vaginal perforation smears were collected daily until the occurrence of first vaginal estrus indicative of pubertal onset in females. The data were analysed by one way-analysis of variance.

RESULTS AND DISCUSSION

Onset of puberty as assessed by occurrence of the first vaginal estrus was delayed in subject females painted with urine of donors held under LLC or short-photoperiod. Control females painted with water exhibited first vaginal estrus significantly earlier than those painted with urine of above donors ($p<0.01$). However, prepuberal females painted with urine of donors subjected to long photoperiodic treatment attained puberty at about the same time when it occured in control females as the difference in mean time taken for first vaginal estrus in these two groups was not statistically significant (27.3±0.78 days vs. 28.4± 0.35 days, C.D.=2.25; Table 1).

Urine from adult donor females maintained under natural light: dark cycle exert a retardative effect on pubertal onset in young females. Results presented in the study demonstrate that the exposure of donor females to long day length abolishes their puberty-delaying property. Exposure to short photoperiod is without any effect on the ability of donors to delay the sexual maturation. Evidently, the photoperiodic manipulations can alter the production/release of the delay chemosignal in adult donor females.

Seasonal breeding is a common reproductive strategy thought to increase the probability of survival of young [8]. In a seasonally changing environment, the day length has been suggested to be the most proximate signal that initiates reproductive activities in mammlas [9]. Social factors acting in concert with environmental factors also influence puberty and reproductive processes in mammals [5, 6]. Adult females perhaps release the delay-chemosignal to communicate the adequacy of reproductive conditions to juvenile females [10]. Urine from isolated or sparsely housed adult females have been found ineffective in causing puberty delay in young female mice [11]. Seemingly, at higher population density when donor females release an effective amount of puberty-delaying chemosignal, long diurnal photoperiod (a signal of the onset of favorable breeding condition) diminishes the efficiency of the puberty-delaying cue in favor of propagation.

ACKNOWLEDGMENTS

This study was supported by a grant from the Department of Science and Technology to SDP and by an award of a Research Associateship to SCP from the Council of Scientific and Industrial Research of India.

REFERENCES

1 Bronson, F. H. and Maruniak, J. A. (1975) Biol.

Reprod., **13**: 94–98.
2 Vadenbergh, J. G., Drickamer, L. C. and Colby, D. R. (1972) J. Reprod. Fertil., **28**: 397–405.
3 McIntosh, T. K. and Drickamer, L. C. (1977) Anim. Behav., **25**: 99–104.
4 Pandey, S. C. (1986) Studies on pheromones in wild mice. Ph.D. thesis, Kanpur Univ., Kanpur.
5 Bronson, F. H. (1985) Biol. Reprod., **32**: 1–26.
6 Drickamer, L. C. (1984) J. Reprod. Fertil., **72**: 55–58.
7 Pelikan, J. (1981) Symp. Zool. Soc. Lond., **47**: 205–230.
8 Sadleir, R. M. F. S. (1969) The Ecology of Reproduction in Wild and Domestic Mammals. Methuen and Co., London.
9 Negus, N. C. and Berger, P. J. (1972) In "Biology of Reproduction: Basic and Clinical Studies". Ed. by J. T. Velardo and B. A. Kasprow, Third Pan Amerian Congress on Anatomy, New Orleans, pp. 89–98.
10 Drickamer, L. C. (1982) Dev. Psychobiol., **15**: 433–442.
11 Pandey, S. C. and Pandey, S. D. (1989) Arch. Biol., (In press)